IN THE CLAIMS:

Claims 24, 38, 48, 50 and 52 were previously cancelled. Please now cancel claim 29 without prejudice, add new claims 54-67 and amend the claims as follows:

1. (Currently Amended) A method comprising:

collecting input data from a seismic survey spread having a plurality of spread control elements, a plurality of navigation nodes, and a plurality of <u>seismic</u> sources and receivers, the input data including:

navigation data for the navigation nodes,

operating states from sensors associated with the spread control elements,

environmental data for the survey, and

survey design data,

estimating positions of the <u>seismic</u> sources and receivers using the navigation data, the operating states, ~~and~~ the environmental data, or combinations thereof;

determining optimum tracks for the <u>seismic</u> sources and receivers using the estimated positions and a portion of the input data that includes ~~at least~~ the survey design data; and

calculating drive commands for at least two of the spread control elements using the determined optimum tracks, wherein the at least two of the spread control elements comprise a seismic source control element and a streamer control element.

2. (Previously Presented) The method of claim 1, wherein the navigation data, the operating states, the environmental data and the survey design data are input to a transform function to perform the estimating, determining, and calculating steps.

3. (Original) The method of claim 2, wherein the positions are estimated according to a spread model within the transform function, and the optimum tracks are input to the spread model for calculation of the drive commands.

4. (Currently Amended) The method of claim 3, wherein the spread model calculates a first set of estimated positions using input that includes at least the operating states and the environmental data, the navigation data includes a second set of estimated positions, and the first and second set of estimated positions are combined with the transform function to produce the estimated <u>seismic</u> source and receiver positions and predicted residuals.

5. (Original) The method of claim 4, wherein the predicted residuals are used to estimate a set of parameters that characterize the spread model, and the spread model parameters are used to calibrate the spread model.

6. (Currently Amended) The method of claim 4, wherein the predicted residuals are use<u>d</u> to estimate error states ~~for sensors used to collect~~ <u>associated with measurements of</u> the environmental data.

7. (Original) The method of claim 2, wherein the optimum tracks are determined according to a weighting function within the transform function, wherein the weighting function receives as inputs the survey design data and the estimated positions.

8. (Original) The method of claim 1, further comprising validating the calculated drive commands and delivering the validated drive commands to the spread control elements, whereby a desirable survey objective may be attained.

9. (Currently Amended) The method of claim 1, wherein the drive commands include commands for controlling at least one ~~of the~~ vessel propeller, vessel thruster, spread component steering device[[s]], ~~and the~~ <u>or</u> vessel cable winch[[es]].

10. (Currently Amended) The method of claim 1, wherein the sensors associated with the spread control elements include one or more sensor types of tension, water flow rate, inclination, orientation, acceleration, ~~velocity, and position~~ <u>or combinations thereof.</u>

11. (Original) The method of claim 1, wherein the collected environmental data includes one or more data types of current, salinity, temperature, pressure, speed of sound, wave height, wave frequency, wind speed, and wind direction.

12. (Currently Amended) The method of claim 1, wherein the survey design data is selected from spread tracks, performance specifications, and survey objectives, wherein the performance specifications are selected from drag and maneuvering characteristics for the vessel, steerable cable devices, steerable ~~seismic~~ source devices, and deflectors, drag characteristic for the towed cables, ~~seismic~~ sources, and floatation devices, and winch operating characteristics.

13. (Currently Amended) The method of claim 1, wherein the survey design data includes one or more data types of area, depth, area rotation or shooting orientation, line coordinates, ~~source and receiver positions,~~ required coverage, local constraints, optimizing factors and historical data~~; and~~
     ~~wherein the collected input data includes one or more data types of pre-survey, operator input, present survey, near-real time, real-time survey, and simulated survey~~.

14. (Currently Amended) The method of claim [[13]]54, wherein the operator input data includes spread parameter settings and environmental data, and wherein the pre-survey data includes environmental sensor data.

15. (Currently Amended) The method of claim [[13]]54, wherein the real-time survey data includes one or more data types of cable tension, water flow rate, inclination, orientation, acceleration, velocity, position, spread control element setting, environmental data, seismic signal and noise data, and operator input.

16. (Currently Amended) The method of claim [[13]]54, wherein the simulated survey data includes one or more data types of simulated pre-survey, simulated operator input, simulated current survey, simulated near-real time survey, simulated real-time survey, and simulated environmental data.

17. (Original) The method of claim 13, wherein the collected input data further includes raw seismic sensor data, and using the raw seismic sensor data to produce quality indicators for the estimated positions, the quality indicators selected from binning datasets, absolute noise data, signal-to-noise ratios, and seismic signal frequency content.

18. (Original) The method of claim 3, wherein the spread model is a hydrodynamic force model of the spread components, a pure stochastic model of the spread components, employing one of the L-norm fitting criteria, or a neural network.

19. (Original) The method of claim 18, wherein the force model contains marine current data.

20. (Original) The method of claim 3, wherein the spread model is a pure stochastic model of the spread components.

21. (Original) The method of claim 3, wherein the spread model employs one of the L-norm fitting criteria.

22. (Original) The method claim 3, wherein the spread model is a neural network.

23. (Currently Amended) A system comprising:
    a seismic survey spread having a plurality of spread control elements, a plurality of navigation nodes, and a plurality of seismic sources and receivers,
    a database for receiving input data for controlling the seismic survey spread including:
        navigation data for the navigation nodes,
        operating states from sensors associated with the spread control
    elements,
        environmental data for the survey, and
        survey design data,

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a computer readable medium having computer-executable instructions for estimating positions of the <u>seismic</u> sources and receivers using the navigation data, the operating states, ~~and~~ the environmental data<u>, or combinations thereof</u>;

a computer readable medium having computer-executable instructions for determining optimum tracks for the <u>seismic</u> sources and receivers using the estimated positions and a portion of the input data that includes ~~at least~~ the survey design data; and

a computer readable medium having computer-executable instructions for calculating drive commands for at least two of the spread control elements using the determined optimum tracks<u>, wherein the at least two of the spread control elements comprise a seismic</u> source control element and a streamer control element.

24. (Canceled)

25. (Currently Amended) A method comprising:

towing a plurality of seismic survey spread elements generally behind a vessel having one or more spread control elements;

providing a set of desired coordinate positions of at least two of the spread control elements<u>, wherein the set of desired coordinate positions is determined using navigation data for a plurality of navigation nodes, operating states from sensors, environmental data for a seismic survey, and survey design data</u>;

independently measuring a set of actual coordinate positions of the at least two of the spread control elements<u>, wherein the at least two of the spread control elements comprise a seismic</u> source control element and a streamer control element;

calculating a difference between the set of desired coordinate positions and the set of actual coordinate positions to form residuals; and

using the residuals as set points in one or more controllers to calculate drive commands for the at least two of the spread control elements.

26. (Original) The method of claim 25 wherein at least one of the controllers uses a PID correction method.

27. (Previously Presented) The method of claim 25 further comprising planning a path for the vessel within a constraint corridor that allows steering available in the spread control elements to achieve a target shape and track for the seismic survey spread elements.

28. (Previously Presented) The method of claim 25 further comprising estimating optimum tracks for tow points of the spread control elements that provide a cross-line component relative to an optimum track for the spread control elements.

29. (Canceled)

30. (Previously Presented) The method of claim 25, wherein each of the drive commands is used to control at least one of position, speed, and heading of the vessel.

31. (Currently Amended) The method of claim 25, wherein the drive commands include commands for controlling at least one ~~of a~~ vessel propeller, [[a]] vessel thruster, [[a]] vessel thruster setting, [[a]] vessel propeller pitch, [[a]] vessel propeller rotation speed, [[a]] vessel rudder angle, or combinations thereof.

32. (Currently Amended) A method comprising:

   towing a plurality of seismic survey sources and receivers generally behind a vessel having one or more spread control elements;

   estimating ~~the~~ one or more positions of the sources based on data received from one or more reference points on a seismic survey spread with respect to the earth; and

   activating ~~only~~ a selected portion of the sources when the selected portion ~~that are~~is within ~~at the proximities~~ a vicinity of ~~the~~ desired cross line positions.

33. (Previously Presented) The method of claim 32, wherein the number of the selected portion of the sources is less than the total number of sources.

34. (Currently Amended) The method of claim 32,

wherein the receivers are towed in a plurality of linear streamers; and

wherein the selected portion of the sources forms at least one linear source array parallel to the streamers.

35. (Currently Amended) The method of claim 32, further comprising:

collecting input data from [[a]] the seismic survey spread having a plurality of spread control elements, a plurality of navigation nodes, and a plurality of sources and receivers;

estimating positions of the sources and receivers using one or more navigation data, one or more operating states, and one or more environmental data;

determining optimum tracks for the sources and receivers using the estimated positions and a portion of the input data that includes at least the survey design data; and

calculating drive commands for at least one of the spread control elements using the determined optimum tracks.

36. (Previously Presented) The method of claim 32, wherein the at least one of the spread control elements is a spread control element for a vessel or a spread control element for a receiver.

37. (Currently Amended) A seismic survey apparatus, comprising:

a vessel;

a plurality of seismic survey sources and receivers generally towed behind the vessel and having one or more spread control elements;

a controller coupled to the seismic survey sources, receivers and the spread control elements, wherein the controller is configured to:

estimate[[s]] the one or more positions of the sources based on data received from one or more reference points on the seismic survey apparatus with respect to the earth; and

selectively activate[[s]] a portion of the sources that [[are]] is closest to ~~at the proximities~~ a vicinity of the desired cross line positions.

38. (Canceled)

39. (Previously Presented) The method of claim 25, wherein the spread control elements comprise a vessel control element, a source control element, and a streamer control element in coordination with each other.

40. (Previously Presented) The method of claim 25, wherein the spread control elements comprise a vessel control element and a source control element in coordination with each other.

41. (Previously Presented) The method of claim 25, wherein the spread control elements comprise a vessel control element and a streamer control element in coordination with each other.

42. (Previously Presented) The method of claim 25, wherein the spread control elements comprise a source control element and a streamer control element in coordination with each other.

43. (Previously Presented) The method of claim 25, wherein the spread control elements comprise at least two vessel control elements in coordination with each other.

44. (Previously Presented) The method of claim 43, wherein one of the at least two vessel control elements is associated with a first vessel and another of the at least two vessel control elements is associated with a second vessel.

45. (Previously Presented) A method, comprising:

providing a seismic survey spread having one or more vessels and one or more spread control elements, wherein the spread control elements comprise one or more

vessel control elements, one or more source control elements and one or more streamer control elements; and

controlling the seismic survey spread by coordinating the positioning of the vessel control elements, the source control elements and the streamer control elements.

46. (Previously Presented) The method according to claim 45, wherein coordinating the positioning of the vessel control elements, the source control elements and the streamer control elements comprises:

providing a set of desired coordinate positions of the spread control elements, wherein the set of desired coordinate positions is obtained from one or more data types selected from operating states from sensors associated with the spread control elements, environmental data for the survey and survey design data;

independently measuring a set of actual coordinate positions of the spread control elements;

calculating the difference between the set of desired coordinate positions and the set of actual coordinate positions to form residuals; and

using the residuals as set points in one or more controllers to calculate drive commands for the spread control elements.

47. (Currently Amended) A method, comprising:

providing a seismic survey spread having one or more vessels and one or more spread control elements, wherein the spread control elements comprise one or more vessel control elements, one or more streamer control elements and one or more source control elements;

estimating one or more positions of the spread control elements based on data received from one or more acoustic positioning receivers and one or more reference points on a seismic survey spread with respect to the earth; and

controlling the seismic survey spread by coordinating the positioning of the vessel control elements and the source control elements based on the estimated positions.

48. (Canceled)

49. (Currently Amended) A method, comprising:

providing a seismic survey spread having one or more vessels and one or more spread control elements, wherein the spread control elements comprise one or more vessel control elements, one or more source control elements and one or more streamer control elements; and

controlling the seismic survey spread by coordinating the positioning of the ~~spread~~ streamer control elements and the source control elements.

50. (Canceled)

51. (Currently Amended) A method, comprising:

providing a seismic survey spread having a first vessel, ~~and~~ a second vessel, the first vessel having a first vessel control element, and the second vessel having a second vessel control element;

estimating one or more positions of the first vessel control element and the second vessel control element based on data received from one or more acoustic positioning receivers and one or more reference points on the seismic survey spread with respect to the earth; and

controlling the seismic survey spread by coordinating the positioning of the first and second vessel control elements based on the estimated positions.

52. (Cancelled)

53. (Previously Presented) The method of claim 1, wherein the positions are estimated according to a spread model used to predict residuals, and further comprising:

using the predicted residuals to estimate one or more parameters of the spread model; and

feeding the parameters back into the spread model.

54. (New) The method of claim 1, wherein the collected input data includes one or more data types of pre-survey, operator input, present survey, near-real time, real-time survey, and simulated survey.

55. (New) The method of claim 6, wherein the measurements comprise current, wind or combinations thereof.

56. (New) The method of claim 32, wherein the reference points comprise at least two reference points located on opposite corners of the seismic survey spread.

57. (New) The method of claim 32, wherein the reference points comprise at least two reference points, and wherein each reference point is located at a corner of the seismic survey spread.

58. (New) The method of claim 32, wherein estimating the positions of the sources comprises estimating the positions of the acoustic positioning receivers on the sources.

59. (New) A method, comprising:

providing a seismic survey spread having one or more vessels, one or more source arrays and one or more spread control elements, wherein the spread control elements comprise one or more vessel control elements, one or more source control elements and one or more streamer control elements; and

steering the source arrays in an inline motion using the vessel control elements;

steering the source arrays in a cross line motion using the source control elements; and

coordinating the positioning of the vessel control elements, the source control elements and the streamer control elements.

60. (New) The method of claim 59, wherein the source control elements comprises a winch system relative to one or more outer streamer tow ropes.

61. (New)   The method of claim 32, wherein steering the selected portion of the sources comprises steering the selected portion within a cross line corridor to the vicinity near the desired cross line positions.

62. (New)   The method of claim 45, further comprising estimating one or more positions of the spread control elements based on data received from one or more acoustic positioning receivers and one or more reference points on the seismic survey spread with respect to the earth, wherein the positioning of the vessel control elements, the source control elements and the streamer control elements are coordinated based on the estimated positions.

63. (New)   The method of claim 45, wherein the seismic survey spread is controlled for reoccupying coordinates from a prior survey to achieve a 4D time-lapsed seismic survey.

64. (New)   The method of claim 49, further comprising estimating one or more positions of the spread control elements based on data received from one or more acoustic positioning receivers and one or more reference points on the seismic survey spread with respect to the earth, wherein the positioning of the streamer control elements and the source control elements are coordinated based on the estimated positions.

65. (New)   The method of claim 1, wherein the sensors measure tension, water flow rate, vertical inclination, body orientation, acceleration or combinations thereof associated with the spread control elements.

66. (New)   The method of claim1, wherein the at least two of the spread control elements further comprise a vessel control element.

67. (New)   The method of claim 32, further comprising estimating the positions of the sources based on data received from one or more acoustic positioning devices.